MID-INFRARED REFLECTANCE SPECTRA OF LUNAR SAMPLES: CHRISTIANSEN FREQUENCY CORRELATIONS WITH COMPOSITION. B. H. Betts, San Juan Capistrano Research Institute, 31872 Camino Capistrano, San Juan Capistrano, CA 92675, Email: betts@sji.org.

Summary. As part of a broad study to characterize the mid-infrared reflectance properties of lunar samples, we have taken mid-infrared (2.2-23 µm, 4 cm^{-1} resolution) FTIR reflectance spectra of several soil samples from all six Apollo sites. We have compared the location of the Christiansen Frequency (CF) (reflectance minimum) with indicators of bulk composition. For lunar soils, we find a loose, but significant, correlation between the CF (a spectroscopic parameter) and the SCFM index (parameter indicative of bulk mineral content: SiO_2 / (SiO_2 + CaO + FeO + MgO) [1]). There is much less, if any, correlation between CF position and SiO_2 % alone. We also see groupings in a plot of CF versus SCFM that correlate with mission in some cases (particularly for the less mafic Apollo 14 and 16 soils), and in the case of Apollo 17, that correlate with different geologic units. Thus, use of the CF in thermal emission spectroscopy holds promise for general mineralogic and geologic characterization of the lunar and perhaps Mercurian surfaces, but clear distinctions can only be made when comparing significantly different CF values.

Background. This work is part of a comprehensive study underway to catalog and understand the mid-infrared spectral properties of lunar materials for comparison with current and future infrared emission spectroscopy of the lunar and Mercurian surfaces. The mid-infrared is more sensitive than other spectral regions to certain significant minerals, *e.g.*, plagioclase feldspars. Relative to earlier preliminary works [2,3], we have now analyzed many more lunar soil samples that were selected to provide a much wider variety of composition, and a better coverage in mission locations and geologic units.

Here we present data and analysis of the Christiansen Frequency, a reflectance minimum near 8 µm, known to often correlate with mineralogical composition in terrestrial silicates [*e.g.*, 1, 4]. To test its correlation or lack of correlation with mineralogical composition in lunar soil samples, we compare it with two parameters, SiO_2 percentage alone, and the SCFM index (shown by [1] to be a useful quantitative parameter for mineralogic comparison with spectral features in terrestrial samples).

Experimental Method. Biconical diffuse reflectance spectra were measured in our laboratory in dry CO_2-free air using an FTIR spectrometer covering 2.2-23 µm with a cooled HgCdTe detector. Sample reflectances were ratioed to the reflectances of a reference standard, gold-coated sandpaper [5]. Samples were placed in sample cups with their horizontal surfaces at the focal plane of the spectrometer.

Results. Figure 1 shows a plot of CF wavelength versus SCFM index. These two parameters, one spectral and one indicative of mineralogic composition, show a loose, but significant, correlation. Particularly because soils should dominate remote lunar spectra, these results indicate that the CF can probably be used with some success to map rough mineralogic composition on the lunar surface, but that only relatively large mineralogic variations can be distinguished.

Figure 2 shows much less, if any, correlation between the position of the CF and SiO_2 alone, indicating that the SCFM index is a better mineralogic parameter to use in comparison with lunar materials' CF. This is consistent with findings for terrestrial materials [1].

In Figure 1, also note some of the "groupings" of points that occur. All of the A14 and A16 samples are located in the upper left, owing to their less mafic, and more anorthositic compositions. A17 samples split into three clumps. The lowest SCFM A17 sample looks anomalous relative to the rest of the plot, and in fact it is. It (sample 74220) was sampled from a band of orange glass on the lunar surface, and some investigators interpret it as a friable clastic rock and not as a soil. The other two groupings of Apollo 17 samples are interesting because they correlate with geologic units: the two to the lower right in Figure 1 were collected from the Valley Floor geologic unit, and the three farther to the upper left are from the Light Mantle unit.

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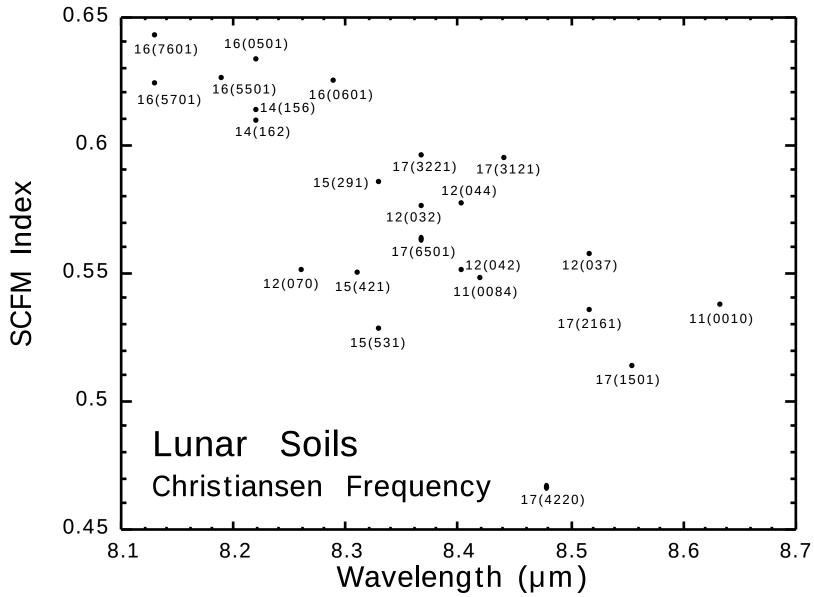

Figure 1: Wavelength of the Christiansen Frequency (CF) (reflectance minimum) versus SCFM index for a variety of lunar soils. Numbers by the points indicate the mission from which the sample was collected. Note the loose correlation, with higher SCFM (less mafic) samples having lower CF wavelengths. Also note the grouping of some landing site soils (see text).

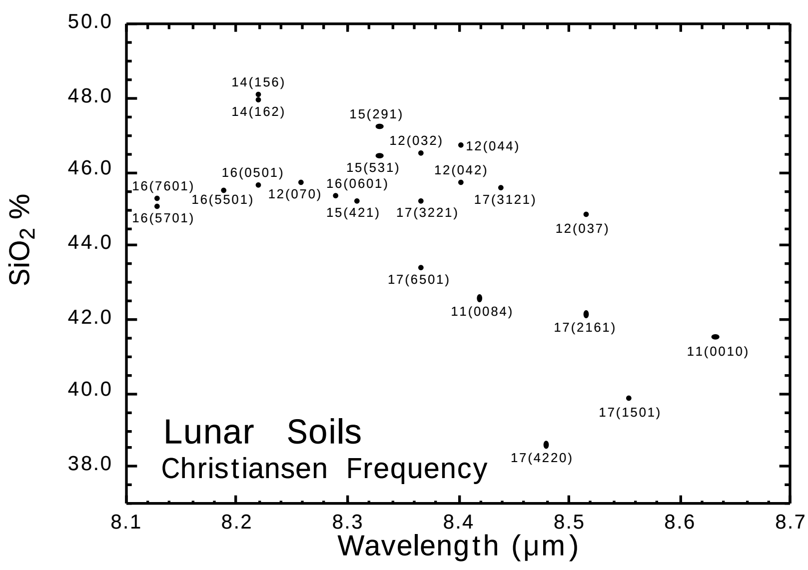

Figure 2: CF wavelength versus SiO_2 %. Note there are some similarities to Figure 1, but there is little, if any, correlation when plotting against SiO_2 % alone, as opposed to SCFM index.